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The Frequency Curve of Daily Rainfall

In a paper on "30 Years' Rainfall at the West of Scotland Agricultural College, Kilmarnock" in *British Rainfall*, 1931, Mr. W. Dunbar gives data from which I have computed the values of rainfall probability shown in the lines marked (*a*) in the following table:—

PROBABILITY OF DAILY RAINFALL WITH SPECIFIED LOWER LIMIT.

(*Kilmarnock, averages* 1901-1930.)

			0.01 in.	0.04 in.	0.10 in.	0.20 in.	0.30 in.	0.40 in.	0.50 in.	0.60 in.	0.80 in.
Jan.	Obs.	(*a*)	0.69	0.56	0.42	0.26	0.17	0.10	0.07	0.04	0.01
	Calc.	(*b*)	0.64	0.56	0.42	0.26	0.17	0.10	0.07	0.04	0.01
July	Obs.	(*a*)	0.54	0.40	0.28	0.17	0.11	0.07	0.05	0.03	0.02
	Calc.	(*b*)	0.44	0.39	0.29	0.18	0.11	0.07	0.05	0.03	0.01
Year	Obs.	(*a*)	0.58	0.46	0.33	0.20	0.13	0.08	0.05	0.03	0.01
	Calc.	(*b*)	0.54	0.46	0.34	0.21	0.13	0.08	0.05	0.03	0.01

The entry in each case represents the random probability of registering an amount of rainfall, in 24 hours, equalling or exceeding the value given at the top of the column. Thus in July the observed probability of a daily rainfall of 0.10 inch or more is 0.28, this figure having been derived from the fact that during the 30 years of observation, 28 per cent. of all days in July gave a reading of 0.10 inch or more.

A curve formed by plotting the probability (or the percentage

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frequency) as ordinate against the limiting value of the rainfall as abscissa gives a great deal of useful information. In particular the "median," "upper quartile" and "upper decile" values of the rainfall are ascertained at once by reading off the abscissæ corresponding with the percentage values 50, 25 and 10 respectively. When the curve for Kilmarnock for the whole year was drawn it seemed to bear a strong resemblance to a logarithmic curve and the values were accordingly replotted

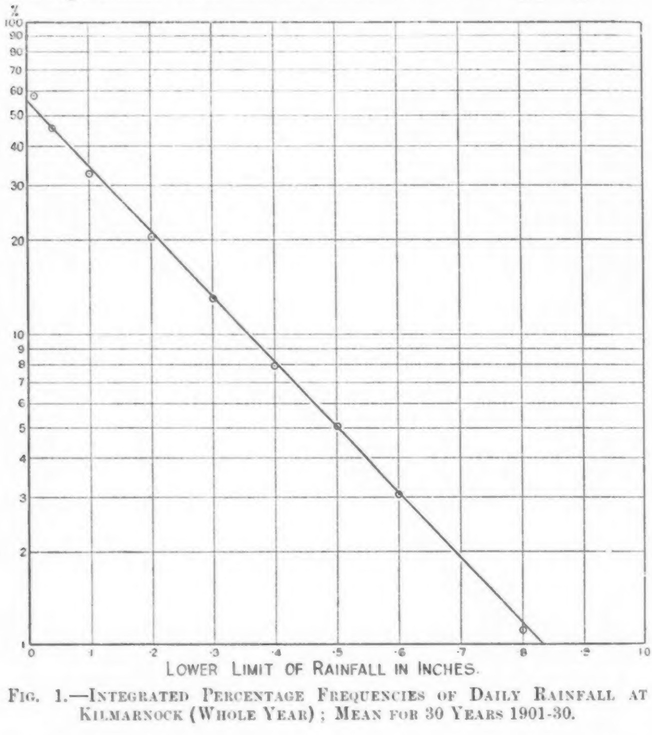


FIG. 1.—INTEGRATED PERCENTAGE FREQUENCIES OF DAILY RAINFALL AT KILMARNOCK (WHOLE YEAR) ; MEAN FOR 30 YEARS 1901-30.

on semi-logarithmic paper. It was then seen that for values of rainfall 0.04 inch and upwards the plotted points lay almost exactly on a straight line, indicating that the percentage frequency F and limiting rainfall r were related by an equation of the form, $\log F = a - br$. The graph is reproduced (fig. 1). A similar result was obtained with the values in individual months. In the above table the values marked (*b*) are those read off from straight lines giving the best fit, as estimated by

eye, with the points plotted on semi-logarithmic paper. The agreement with the observed values is very close indeed and we are justified in concluding that at Kilmarnock the integrated frequency curve of daily rainfall is of logarithmic form for rainfall values of 0.04 inch or more.

It seems unlikely that this phenomenon is confined to Kilmarnock and it is hoped in due course to publish the results of examining the data for a number of stations.

E. G. Bilham.

The Rainfall of Malta with a remark on long-period forecasting

In the course of an investigation on the climate of the Maltese Islands the rainfall has received attention from a rather unusual angle with results of some general interest.

The information given by a crude statement of the number of rain-days at a station, while providing some idea of the character of the climate, is by no means complete and may be misleading. In the first place the definition of a rain-day as a day with, say, 0.2 mm. or more of rain eliminates a possibly large number of days when rain falls; and the total number of days with rain, however small the amount, may have more climatological significance than the number of official rain-days. Moreover, while the total amount yielded on the days with less than the defining amount is certainly negligible when considered as a contribution to the total annual rainfall, it is by no means equally evident that falls of 0.2 mm. are necessarily significant.

TABLE I.

Daily fall in mm.	less than 0.2	0.2–1.0	1.1–5.0	5.1–10.0	10.1–20.0	20.1–40.0	Over 40.0
Percentage of total fall	Negligible	3	14	18	28	23	14
Percentage of number of days with rain	25	23	26	12	9	4	1
Percentage of number of rain-days	—	30	35	16	12	5	2

To give anything like a complete statement it is necessary to consider the relative frequency of daily falls of different amounts, and with this object in view the rainfall for the ten years 1922-32 has been analysed according to the daily amount of rain, using the intervals bounded by the value 0.0, 0.2, 1.0,

5.0, 10.0, 20.0 and 40.0 mm. In Table I percentages are given showing the proportions of the total rainfall, the number of rain-days and the number of days with rain, however small the amount, due to daily falls within the different ranges, while in fig. 1 the same information is given diagrammatically in the form of sum-curves, which are much better adapted to the representation of such distributions than are curves of fre-

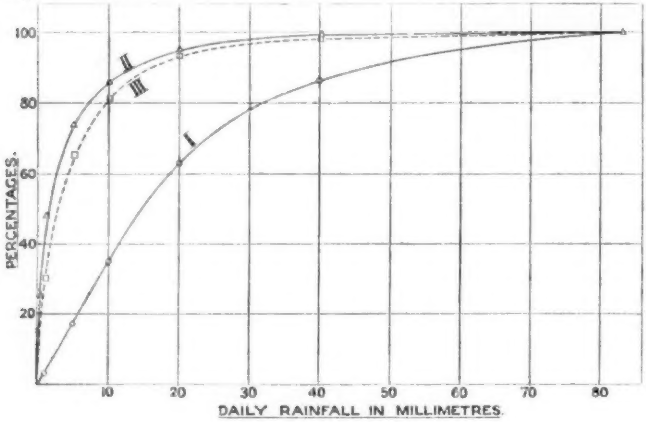


Fig. I.

quency. Thus the ordinates of the three curves in fig. 1 are defined as follows:—

Curve I.—The ordinate gives the percentage of the total rainfall due to daily falls of amount less than that defined by the abscissa.

Curve II.—The ordinate gives the number of days with rain of amount less than that defined by the abscissa, as a percentage of the total number of days with rain.

Curve III.—As in II, but considering only "rain-days," that is, ignoring falls of less than 0.2 mm.

It is possible from these curves to determine the importance of various daily amounts as contributions to the total rainfall, the number of days with rain or the number of rain-days, as, for example, that falls of 1 mm. or below while accounting for 30 per cent. of rain-days and 48 per cent. of days with rain give only 3 per cent. of the total rainfall. For all practical purposes such an amount of rain is of no significance, so that there would be a case for putting the definition of a "rain-day" at something like 1 mm. rather than 0.2 mm. At the other end of the scale it is observed that falls over 20 mm. give 37 per cent. of the rain on only 7 per cent. of rain-days, while

falls over 40 mm. account for only 2 per cent. of rain-days while yielding, in the mean, 14 per cent. of the amount. It is clear, therefore, that while the frequency of heavy falls decreases as the amount increases the decrease is not sufficiently rapid to compensate for the heaviness of the fall until very large values are reached. The division at 10 mm. is of particular interest, for above that daily amount we have 65 per cent. of the rain with only 19 per cent. of the days, that is the bulk of the rain on a small proportion of the days. It may therefore be inferred that the rainfall in any individual year is determined largely by the daily falls of 10 mm. or over, a fact which is very clearly brought out by fig. 2, where, for each of the ten years 1922-32, the annual amounts due to falls above and below 10 mm. per day have been determined and plotted as ordinates with the total rainfall as abscissæ. It will be observed that the triangles marking the amounts due to the lighter falls are distributed round a line of small slope showing that these falls contribute a more or less constant amount to the total rainfall. The circles, on the other hand, giving the amounts due to daily falls over 10 mm., define a line of much larger slope proving that the total rainfall is mainly determined by these falls. The indication of figs. 1 and 2 is quite definite, and it is given as a fact of considerable importance that the total rainfall at Valletta is largely determined by the amounts yielded on the few days (on the average about 15 per year) with over 10 mm.

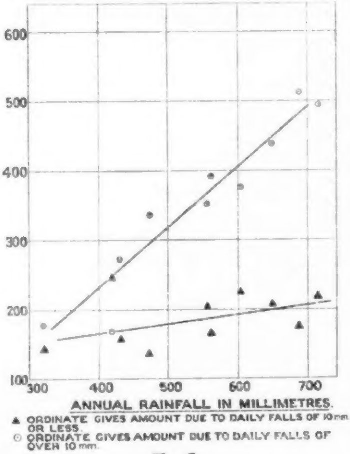


Fig. 2.

This result is of great significance when dealing with the rainfall of Malta from the point of view of seasonal forecasting, for a year of large rainfall need not be one of really abnormal raininess in any general sense but merely one with a few more occurrences of heavy rain than the average, so that we are dealing in statistics with the rainfall due to a small number of occasions, which is most unsatisfactory material for statistical treatment, while in seasonal forecasting we are attempting to estimate the yield of a few heavy falls, a very different problem from anticipating the general tendency of a season.

Now, the ocurrence of rain depends upon the association of

suitable values of many factors so inter-related that a small change in one of them may imply profound changes in future developments, as is evident, for example, in cases of vertical instability, where a small difference in temperature or humidity at some level may entirely alter the course of events over a very wide field. There is a more than superficial analogy between meteorological events in general and the small-scale phenomena of turbulence or the yet smaller of molecular motion, and detailed forecasting will probably never be feasible beyond a certain time determined by the stability and inertia of " present conditions." While long-period forecasting does not aim at giving more than a general indication of the character of a season, it is very important to establish that the values of the quantity to be forecast are not mainly determined by occasional large fluctuations, before its treatment by correlation, periodicities or other statistical method can be justified. For if particular outstanding values are important, the forecasting of mean values involves the same problems as detailed forecasting and has therefore the same limitations.

The nature of meteorology is such that the frequency distributions of the values of many factors is far from " normal," and probably in many cases exceptional values are most important. For example, in many regions the greater part of the annual rainfall is probably due, as in Malta, to a few disturbances giving comparatively large amounts, while mean anomalies of pressure may frequently be largely determined by the few occasions of large anomaly. Every particular case should be examined critically, but without further investigation strong support must be given to the point of view held by many meteorologists that seasonal forecasting is, in some cases (of which the rainfall of Malta is one definite example), not only difficult but quite impracticable.

R. C. Sutcliffe.

Meteorological Records from the northern Pennines

The high fell country of the north Pennines, comprising the country between upper Teesdale, the valley of the South Tyne, Weardale, and the valley of the Eden on the west, is notable as it provides the most considerable extent of upland above 1,500 feet in England. This bleak and elevated tract, however, is by no means devoid of population; the highest villages in England, the highest main roads, and what the writer believes to be the highest inhabited house, are all to be found in the Crossfell region. In the past, records of temperature have been kept at Alston (1,145 feet) and Allenheads (1,360 feet), and they are quoted in Bartholomew's Atlas of England and Wales.

Rain-gauges, rather on the fringe of the area, are kept at Alston, in Lunedale and Baldersdale to the south, and at Newbiggin in Teesdale. Several high-level gauges are also to be found on the east, around the head of Weardale, in connexion with the new reservoir of the Durham County Water Board. Of these, the highest is at 1,950 feet. On the higher ground nearer Crossfell, however, no meteorological records have been kept until this year, as far as the writer is aware.

With a view to futher investigation of the climate of these uplands, the writer has established a thermograph in a Stevenson screen at Moor House, a keeper's cottage in extreme upper Teesdale, the Council of the Durham Colleges having made a small grant to defray expenses. The keeper, Mr. Armstrong, has most kindly undertaken the weekly changing of the charts, and records have been kept since January 23rd. The height of the station above sea level is 1,840 feet, considerably higher than any other station hitherto in operation in Great Britain, with the exception of Ben Nevis. Moor House is also the more interesting in that it lies in the midst of completely uncultivated moorland, excepting the small hayfield in front of the house: the nearest inhabited house is about four miles distant. The thermograph screen is in a small enclosure near the house, which stands on ground sloping north-west to a valley. The stream is about 60 feet below the level of the house and 200 yards from it.

The records so far show several features of interest, although it is too early to embark on an extensive discussion as yet. Further, the winter has been much more open than usual, in contrast to the experience of 1931, when the track leading to the house was blocked by snow for over two months. This year snow lay on north slopes for about five weeks in all, but never attained any great depth. The abundant February sunshine cleared the south slopes rapidly after the falls of the second week, and the falls in March, April and May were never large.

Temperatures, compared with those of Durham (336 feet), show, over six months, an average difference almost exactly what might be expected, 5.4°F. for 1,500 feet. The daily range, however, is less at Moor House, except during the month of June, which, as usual towards the north-east coast, was marked at Durham by a good many days of "sea-fret" and cloudy weather. Maxima have averged 6.5° below those of Durham, minima 4.3°. It may further be pointed out that the Durham station is on a ridge and that considerably lower minima often occur at the valley station of Houghall, two miles distant. The small range at Moor House, however, may largely be attributed to the frequent mists which cover the Crossfell plateau, and the strong winds. On those rare nights which are both clear and calm, temperatures may fall very low, e.g., a

minimum of 20° on May 8th. The coldest night so far recorded was that of March 11th—12th, minimum 11.5°. Frequently on winter nights the minimum occurs before midnight, after which the trace shows sharp fluctuations; the writer is inclined to suggest that these may be due to disturbance of the air in the shallow valley by slight gusts, but so far there has not been much opportunity for forming an opinion.

The following figures may be quoted for the station; however, the records for several days in May and early June are imperfect owing to the pen-arm sticking after a long period of damp, misty weather, so that the results for the month (marked with an asterisk in the table) are only to be regarded as approximate.

	Mean	Mean Maximum	Mean Minimum	Extremes for Max.		Month and Dates Min.	
February	32·8	37·4	28·2	47	3rd	18·5	17th
March	33·8	38·4	29·1	48	23rd	11·5	12th
April	35·5	40·6	30·4	50·5	29th	21·5	3rd
May	42·4*	46·9*	37·8	56	31st	20	8th
June	49·5*	57·6*	41·5	69·5	17th	33	16th
July	53·2	58·8	47·6	70	10th	41	18th
August	53·9	60·4	47·5	77	11th	31	24th

GORDON MANLEY.

OFFICIAL NOTICE

Discussions at the Meteorological Office

The series of meetings for the discussion of recent contributions to meteorological literature, especially in foreign and colonial journals, will be resumed at the Meteorological Office, South Kensington, during the session 1932-3. The meetings will be held on alternate Mondays at 5 p.m., beginning on Monday, October 17th, 1932, when Dr. G. C. Simpson, C.B., F.R.S., will open the discussion of a paper entitled "The structure of wind over level country. Report on experiments carried out at the Royal Airship Works, Cardington," by the late M A. Giblett, M.Sc., and other members of the staff of the Meteorological Office (*London, Meteor. Office, Geophys. Mem., No.* 54).

The dates for subsequent meetings are as follows:—

October 31st, November 14th and 28th, December 12th, 1932; January 16th and 30th, February 13th and 27th and March 13th, 1933.

The subjects for discussion for the next two meetings are:—

October 31st, 1932. *Terrestrial-magnetic activity and its relation to solar phenomena.* By J. Bartels (Terr. Mag., Washington, D.C., 37, 1932, pp. 1-52). *Opener*—Mr. R. A. Watson, B.A.

November 14th, 1932. *The problem of the dissipation of fog.*

By A. Baldit (Météorologie, Paris, 7, 1931, pp. 383-97) (in French). *Opener*—Mr. C. H. Kellett, B.Sc.

The Director of the Meteorological Office wishes it to be known that visitors are welcomed at these meetings.

OFFICIAL PUBLICATION

The following publication has recently been issued :—

Annual Report *of the Director of the Meteorological Office presented by the Meteorological Committee to the Air Council for the year ending March* 31, 1932.

In its main lines the work of the Meteorological Office during the year under review has continued as in previous years, but the demands made on the Office have continued to grow and every department reports an increase in the number of inquiries received and the amount of information supplied. The year is noteworthy for the completion of three undertakings, the complete reorganization of the arrangements made at Headquarters in London for the preparation of weather forecasts, the successful conclusion of a scheme for simplifying the exchange of meteorological information between the countries of the northern hemisphere, and the completion of a series of tours made by the Superintendent of the Navy Services to the chief naval stations of the world, in order to organize the supply of meteorological information to the Royal Navy when on foreign service.

Before the reorganization of the forecasting arrangements, the supply of forecasts for aviation and for other purposes was the work of two separate divisions, but there was no essential difference between the two types of forecast and they have now both been placed in charge of the Forecasting Division, thus avoiding a certain amount of duplication. Forecasting work has also been facilitated by the simplification of the exchange of weather information between different countries, which required close international co-operation. After some initial difficulties, the new system is now working smoothly and regularly.

The Aviation Service has provided special assistance for a number of long-distance flights, including two to Australia, two to Africa and one to Japan, and also, in connexion with several projected trans-Atlantic flights, for the cruise of the airship *Graf Zeppelin*, and for the first successful flight by a glider across the English Channel. A beginning has been made, in co-operation with the Automobile Association, with a special service for the supply of meteorological information to owner pilots.

During 1932-3 will be held the Second International Polar Year, during which a number of countries will send expeditions to high latitudes to obtain data for studies in meteorology and

terrestrial magnetism. The Meteorological Office has organized a British expedition to Fort Rae in Canada, under the leadership of Mr. J. M. Stagg, who visited the site during 1931 to make preliminary arrangements. At the end of the year preparations were well advanced for the departure of the party in May, 1932.

Correspondence

To the Editor, *The Meteorological Magazine.*

Summer Weather in Ungava Bay

In the *Meteorological Magazine* for August, 1932, there is an article by Mr. S. T. A. Mirrlees under the above heading, from which it would appear that there are practically no meteorological records for the Hudson Straits region. This is far from being the case, as the Meteorological Service of Canada has stations at the following places:—

Station	No. of Years' Observations	Lat. N. °	Lat. N. ′	Long. W. °	Long. W. ′
Lake Harbour (Ashe's Inlet) ...	24	62	50	70	40
Pond Inlet	7	72	43	77	45
Fort Chimo	8	58	10	68	10
Port Harrison	8	58	25	78	21
*Hope's Advance	5	61	5	69	33
*Nottingham Island	6	63	7	77	56
*Resolution Island	3	61	18	64	53
Pangnirtung	4	66	9	65	30
*Chesterfield Inlet	10	63	45	91	50
*Churchill	46	58	51	94	11

* There are wireless stations at these places also.

At five of the places there are wireless stations and weather reports are received from them twice a day. A record of the observations is published in our *Monthly Record of Meteorological Observations*, and some of them are summarised in an article in the *Canada Year Book* for 1930.

J. PATTERSON, *Director.*

Department of Marine, Meteorological Service of Canada, Toronto 5, Ontario. September 17th, 1932.

The Thunderstorm of August 12th, 1932

The times given in the September number of the *Meteorological Magazine* show that the storm at Rickmansworth broke out only about ten minutes later than its arrival over South Farnborough, although the former place is 27 miles off in a direction N.26°E. My remark in the same number, to the effect that the storm travelled in a south-south-west upper

current of the order of 30 m.p.h., was based on the pilot balloon observations in south-east England between 5,000 and 9,000 feet, the highest level observed. The Duxford aeroplane pilot gave 5,200 feet as the height of the cloud base. It is evident that the short time interval noted above was due to a development rather than to a drift. The relatively long duration of the Rickmansworth storm indicates some elongation along the upper current. The cold front was oriented about north to south and was moving at an average speed of about 17 m.p.h., so that one would have expected it to pass Rickmansworth fully 40 minutes later than South Farnborough. There was no close relation between the front and the storm, which occurred an hour after the front over the London area, including Croydon. An elongation along the upper current is fairly common, and is not always simply related to a front. Attention may be called to the thunderstorm of July 20th, 1929,* when a pronounced line-squall moved in an unusual direction from south to north, whereas the heavy rain splashes were on a belt from roughly south-west to north-east, and the London storm was on the whole elongated in that direction. When a cold front is less sharply defined it is complicated by local squalls caused by heavy rainfall, and it is sometimes impossible to unravel the puzzle.

There is a need for further investigation into the structure of thunderstorms, based on synchronous maps at short intervals. Perhaps the variation of wind with height is important. If the elongation is parallel to the shear, it would be along the upper current in the fairly numerous cases when the wind increases with height without changing direction. Sometimes the elongation is across the upper current. The London storm on the night of August 20th, 1932, was an example of this, and in consequence the heavy rain only lasted for about ten minutes. The heavy rain reached Croydon at about 23h. 10m., and Kingsway between 23h. 30m. and 23h. 35m. G.M.T., the speed showing reasonable agreement with what one would have expected from the upper current. (At 8,000 feet at South Farnborough at 18h. 20m. the wind was SSW., 31 m.p.h.; at Lympne at 17h. 20m., SSW., 34 m.p.h.; Kingsway is 11½ miles due north of Croydon aerodrome.)

C. K. M. Douglas.

September 26th, 1932.

Thunderstorm Phenomena

While at Grayshott during August, I observed thunderstorms on the 12th and 20th, both of which were remarkable for the

*See *Meteorological Magazine*, 64, 1929, p. 156 and p. 187.

exceptional frequency of the lightning and thunder. On the 12th thunder was first heard at 0h. 20m. G.M.T., and the discharges were so numerous that it was not until 1h. 40m. that I could with certainty associate a given flash with its appropriate clap in order to find the distance. From 1h. 36m. to 1h. 46m. the thunder roll never ceased; it was followed by 1 second of quiet, and then there was another period of incessant rumble for exactly 6 minutes 40 seconds.

Again, on August 20th from 22h. 59m. to 23h. 14m. I timed a period of 14 minutes 47 seconds of incessant thunder. At 22h. 47m. my father and I were observing the storm, which was then nearly overhead, slightly to south-west, and very severe. A very bright flash occurred and my father, who was facing the flash, reported a " pop," almost simultaneous with it. I was in the doorway writing down a report with my back to the flash. I only saw the reflection and did not hear the " pop." The crash of thunder did not come for at least half a second.

It is difficult to judge between the theories about the " vit " or " click." The reason why I did not hear the " vit " may have been that I did not see the flash, this giving support to the physiological theory. This, however, is upset by the fact that I had just been out in the open and had heard no " vit " with even more severe discharges. On this occasion the theory of induced charges sparking from one object to another is untenable, as the " click " was distinctly heard to the south-west and in that direction there is nothing but a thick wood. Finally, Mr. Best's theory in the *Meteorological Magazine* of July, 1928, p. 135, is hardly adequate to explain such observations as that described by Mr. Absalom in the magazine of August, 1928, p. 163, in which three people heard a " crack " and in the same direction. It is unlikely that three people would all receive the induced charge in the head, and that it would escape in each case so as to give the same apparent direction.

The best way of attempting to settle the matter is for someone to collect data of as many occurrences as possible, and to note the severity of storm, weather, direction with regard to the lightning flash, number of people who heard it, and so on.

In conclusion, it may be of interest to note that on July 22nd there was a distant thunderstorm at 17h. 24m. to the south, and at that time I was on a roof and distinctly saw a lightning flash low down to the south, but not followed by audible thunder. The sky was heavily overcast, but it was not raining, and it was long before sunset. This is the only case I have of lightning without thunder in the daytime.

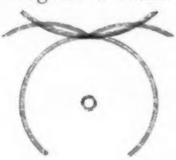
S. E. ASHMORE.

22, *Soho Road, Handsworth, Birmingham. September 25th.* 1932.

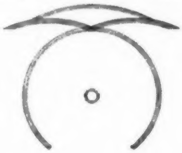
Supplementary Tangent Arcs to the 22° Halo

The Padstow halo complex of May 10th last, as discussed in the *Meteorological Magazine* for July, was *inter alia* noted for the presence of upper and lower tangent arcs supplementary to the usual circumscribed halo which owing to the elevation of the sun, 51°, was fully developed. The question arises what these supplementary arcs represent.

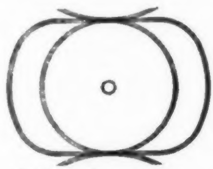
In the discussion it was suggested that they might be the upper and lower Parry arcs. There is, however, a difficulty in this. The lower arc might be the Parry arc but the upper arc was of reversed curvature to the Parry arc, which though nearly flat has a slight curvature concave to the sun. Moreover as Wegener's table shows, at a little less elevation than 50° the



Halo, Ben Nevis, March 4th, 1887, showing supplementary (Kalmar?) tangent arc. Elevation of sun about 24°.



Halo, Boulder Colorado, January 10th, 1918, showing Parry arc. Elevation of sun 19° 15′.



Padstow halo of May 10th, 1932, showing Kalmar arcs. Elevation of sun 51°.

middle of the Parry arc falls together with the apex of the 22° halo: as Meyer says, " wenn die Sonne auch nur annahernd in dieser Hohe über dem Horizont steht, ist wenig Aussicht vorhanden den Bogen von Parry zu erkennen." (Even if the sun is only approximately at this altitude above the horizon, there is little prospect that the Parry arc will be recognisable.)

What then might the arcs be? It has been suggested that they might be called the Kalmar arcs after the observer of the very similar Pola complex in 1896. It seems they must have a separate existence from the Parry arcs as an arc very like the upper Kalmar arc was observed at Ben Nevis, March 4th, 1887, at an elevation much lower than the Padstow complex and at which the Parry arc if present would have been conspicuous.

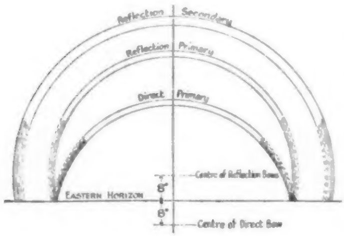
CICELY M. BOTLEY.

Guildables, 17, *Holmesdale Gardens, Hastings*. *August 20th*, 1932.

Reflection Rainbows

At about 8 p.m. on August 21st, while walking about a mile north of Bude (which faces due west) and a mile inland, I saw the bright lower limbs of a rainbow formed by the reflection of

the setting sun from the surface of a calm sea. The sun itself, at an altitude of about 8°, was at first obscured by clouds which shortly cleared somewhat and allowed a direct bow to appear. Parts of a moderately bright reflection secondary were visible, but I could not see any part of a direct secondary. The direct primary and reflection primary met, as would be expected, on the eastern horizon, the direct primary making an acute angle, and the reflection primary an obtuse angle, with the horizon. Thus, parts of three bows were visible. My altitude was about 100 feet above ordnance datum.



I do not know whether this phenomenon is common, but the conditions were perhaps rather unusual—a stormy sky, calm sea with westerly aspect, and light clouds moderating the rays of the sun direct to the observer but not obscuring the rays falling on the sea.

The enclosed sketch is roughly to scale, the radii being taken at the theoretical values of about 42° and 51° for the red rays and 40° and 54° for the violet rays of the primary and secondary bows respectively. Orange and red are represented by broken lines, blue and violet by full lines; portions not visible are left blank. The angle of the reflection bows appeared to be more obtuse than that on the sketch.

W. D. REYNOLDS.

11, *Victoria Street, London, S.W.*1. *September 9th*, 1932.

Vivid Meteor seen from Eskdalemuir

An unusually bright meteor was observed at Eskdalemuir, at 18h. 31m. G.M.T. on Monday evening, September 26th, 1932. Although it was quite light, between sunset and night, the colours were most vivid. The head of the meteor was like a brilliant electric blue rod, which gradually diverged into a yellow and yellowish-brown tail from which small globules were streaming.

When first seen it was due east of the Observatory, moving rapidly towards the south in a straight line at an elevation of 40°. After being visible for about three seconds it disappeared in a direction east-south-east from the observatory.

At the time of vision the wind was north by east, with velocity 5 metres per second.

R. E. WATSON.

The Observatory, Eskdalemuir, Dumfriesshire. October 3rd, 1932.

Line Squall in Cornwall

At about 15h. 15m. G.M.T. this afternoon there was a line squall in the north-west. It lasted about 15 minutes. The background was of very black nimbus cloud surmounted by a swirling tapering cumulus cloud. Some spectators declared it to be a waterspout; but it did not touch earth or water anywhere. It looked very much like the picture of a line squall which appears in the front of the Meteorological Log Book as supplied to the Nautical College, Pangbourne.

E. MICHAEL SHAW.

St. John's Vicarage, Penzance, Cornwall. September 9th, 1932.

Extremes of Heat in August

In criticizing the assumption made by "the meteorological correspondent of an important newspaper" that if meteorological conditions *precisely similar* to those of August 19th last had happened to obtain in July the temperature of 99°F. registered at Greenwich on that date would have been exceeded, Mr. Bonacina clearly does not allow the words italicized their full force. "Precisely similar" can only mean "identical in every respect"—that is, with regard not merely to the distribution through the troposphere of pressure, temperature, humidity, radiation and cloudiness, but also to the thermal state of soil, sea and stratosphere. It is surely conceivable that after a period of exceptional warmth from, say, May to the beginning of July all these factors might arrive at the same combination as on August 19th this year a month or six weeks earlier. In that event, still greater heat would necessarily result from the increased altitude (eight to ten degrees) of the sun Some approach to this earlier maturing of the appropriate conjunction of circumstances appears to have occurred in 1868. In south-east England the May of that year was nearly as warm as an average June, and June was fully as warm as an average July. Around the middle of July temperatures above 95°F. were recorded as far north as Manchester. On the 22nd, although the reading at Greenwich was not above 96.6°F., 100.5°F. was attained by a verified thermometer in a "box stand, double, with venetian sides" at Tonbridge; on the previous day 99.9°F. was the maximum given by a similar instrument exposed on a Glaisher stand at Abingdon Pigotts, Royston, Cambs.*

Experience suggests to Mr. Bonacina that "August, though averaging a little cooler than July, is actually the month for spurts of extreme heat." It is true that the two highest maximum temperatures on record at Greenwich back to 1841 were registered on August 9th, 1911, and August 19th, 1932; but prior to 1911 the August extreme was 95.1°F. (on the 18th

* See *Symons's Meteorological Magazine*, 3. 1868, p. 130.

of the month in 1893), and this was substantially exceeded by 96.6°F. on July 22nd, 1868, and by 97.1°F. on July 15th, 1881. Since 1841, the greatest heat of the summer has occurred at Greenwich 42 times in July, as against 23 times in August. Furthermore, out of a total of 88 days with maxima at or above 90.0°F., July has provided 47, August 25. There would seem to be no evidence that the applicability of Mr. Bonacina's remark quoted above extends beyond the reign of King George V.

THE METEOROLOGICAL CORRESPONDENT IN QUESTION.

September 30th, 1932.

NOTES AND QUERIES

Flying through a Haboob

An Imperial Airways pilot, Mr. C. G. Lumsden, flying north from El Dueim towards Khartoum on May 31st, 1932, encountered a haboob about 60 miles north of El Dueim. From a distance of about 40 miles and a height of 4,000 feet the appearance was of a buttressed hill rising vertically for 2,000 feet to a gently inclined surface which appeared to merge into disturbed cirrus at 8,000 feet. The vertical wall was composed of sand, advancing westward at the ground under the influence of an east wind of about 35 m.p.h. At 5,000 feet, however, there was no violent wind, and the pilot passed into the haboob between two advanced buttresses. Here visibility dropped to half a mile, there were no bumps, but rain fell although there were no well-defined clouds. Behind the front visibility improved rapidly, and at ten miles' distance it reached ten miles. The length of the front was 25 miles; at its northern edge the wind changed to south, 40 m.p.h., subsequently becoming light and variable.

Hurricane in eastern United States

Mr. Earl C. Austin, of Auburn, Maine, writes that a tropical hurricane from the Gulf of Mexico crossed the eastern parts of the United States of America on September 14th to 17th causing gales and heavy rain; 16.5 in. fell at Appalachicola, Florida, in 36 hours. The storm followed an unusual track; after reaching the coast off the Virginia Capes it turned inland again under the influence of a high to the north-east, and crossed Maine with renewed intensity. Auburn, Maine, received 5.50 in. in 20 hours, Woonsocket, Rhode Island, 9.80 in. and Greenville on Moosehead Lake, 7.40 in., the highest recorded falls in a day at these places. Great damage was caused by floods, many bridges being washed away, while boats were sunk by the high waves on the inland lakes.

Hurricane in Porto Rico

The hurricane which devastated the island of Porto Rico on the night of September 26th-27th appears, according to reports in *The Times*, to have been one of the most intense ever experienced there. Altogether 212 lives were lost, 1,800 persons were injured, and damage to property estimated to exceed ten million dollars occurred on Porto Rico alone; considerable material damage is reported on Barbuda and Santo Domingo, but no loss of life.

The " hurricane season " of the West Indies is at its height in August and September. According to data collected by Mr. O. Fassig, 64 hurricanes were recorded in the vicinity of Porto Rico in the period 1515 to 1929; of these, four of calamitous nature occurred in a period of 130 years, and the most recent of them on September 13th, 1928, when nearly 300 lives were lost. On August 8th, 1899, a severe hurricane occurred, in which it was estimated that 3,000 lives were lost.

The development of wireless telegraphy and the improvement of communication with the outlying districts have had the effect of diminishing the loss of life in these major hurricanes, since the more adequate warning now possible enables the inhabitants to take precautions against the floods which were responsible for great loss of life in the past.

Meteorological Lectures

A course of illustrated lectures and discussions on " The Science of the Weather " is to be given by Mr. L. B. Cundall, at the City Literary Institute, Goldsmith Street, on Thursday evenings at 8 p.m. The course, which will continue through the winter, deals with the physical properties of the atmosphere, instrumental and non-instrumental observations, the weather map, forecasting and climatology. The opening date has not yet been arranged.

Reviews

The Climate of the Netherlands—B (*continued*). *Air- and earth-temperature*. By Dr. C. Braak, K. Ned. Meteor. Inst., No. 102. Med. en Verh. 33, pp. 55 (Dutch) + 20 (English summary). *Illus*. Amsterdam, Seyffardt's Bockhandel, 1930.

This section of the official handbook on the climate of the Netherlands deals chiefly with the distribution of air temperatures, mean, maximum and minimum, over the country. An interesting diagram shows the daily mean temperature over various periods of years, and is used in the investigation of the occurrence of cold and warm spells. Dr. Braak concludes that " the reality of constant deviations cannot be denied without

further research," but it appears also that "the trace of the Ice Saints in the beginning of May cannot be detected with certainty in the curve for 1849-1929, so that the question of cold spells" appears to be one on which general agreement is impossible.

The summary is written in Dr. Braak's usual easy English style, and in conjunction with the earlier parts of the same series gives a most valuable account of temperature conditions in the Netherlands.

S. T. A. MIRRLEES.

Maps showing the rainfall for each month and for the year 1930 *in Australia and Tasmania.* Published by the Commonwealth Meteorologist. 1931. Official—not for sale.

The annual rainfall amounts varied from 2·46 in. in Central Australia to 208·37 in. in Queensland. As much as 63 per cent. of the whole area received more than the average rainfall. Small-scale maps show the area with a rainfall in excess of the average for each year back to 1908. So large an area has been affected only in the years 1910, 1917 and 1921, when the areas with rainfall above the average were 75, 75 and 63 per cent. The rainfall of 1930 was in marked contrast to that of 1928 and 1929, which gave only 13 and 15 per cent. of the whole area with rainfall in excess of the average. These two years gave some of the smallest totals ever experienced in parts of the pastoral country of the eastern interior. The fluctuations in the rainfall experienced in Australia from year to year are similar to those in this country in that excesses or deficiencies but rarely cover the whole country.

The rainfall was, on the whole, well distributed throughout the year, and the pastoral and agricultural position, from the standpoint of production, was generally satisfactory at the close of 1930.

J. GLASSPOOLE.

Obituary

Mr. J. Sheerman.—We regret to learn of the death of Mr. J. Sheerman, on September 27th. Mr. Sheerman was born on March 12th, 1853 and joined the staff of the Meteorological Office in February, 1882. At that time the project of analysing the autographic records obtained at the Meteorological Office Observatories was being vigorously pursued, and the harmonic analyser now in the Museum was built for that purpose. Mr. Sheerman was appointed for this work on account of his proficiency in harmonic analysis, and became the official expert in the use of the machine. The department was then known as the "Pantagraph Room." Mr. Sheerman retained these statistical associations throughout his career, and when the

actual reproduction of the autographic curves was given up, he became responsible for the production of the annual volumes of *Hourly Readings* in which they were tabulated. He also took part in the preparation of the statistical summaries of the meteorological observations obtained during the National Antarctic Expedition of 1902-4.

After he became a Principal Assistant in 1914, Mr. Sheerman had a considerable share in the production of the meteorological sections of the British *Year Book*, until he retired on December 31st, 1919. Thus for a period of nearly 38 years he played a large part in providing the indispensable basis of accurately summarised and digested observations, on which all meteorological investigations must rest.

News in Brief

Col. E. Meseguer has relinquished the post of Director of the Spanish Meteorological Service as a result of his appointment as Inspector-General of the Surveying Department. He is succeeded by Dr. Nicolas Sama, chief of the Forecasting Service.

The Weather of September, 1932

Pressure was below normal generally over Europe and America except over California, a belt extending from north-western United States across north-eastern Canada to Greenland and the central North Atlantic and over a small area in south Russia. Pressure was also above normal to the north-east of the Caspian Sea. The greatest excess was 8.1mb. at Julianehaab and the greatest deficits were 13.6mb. at Vardo, 8.7mb. at 40°N., 70°W. and 5.0mb. at Point Barrow. Temperature was greatly above normal in central Europe, about normal in Scandinavia, slightly above normal in Spitsbergen and below normal in Portugal. Rainfall was below normal in central Europe and Spitsbergen, but above normal in Scandinavia where the excess was 130 per cent in northern Lapland, and 84 per cent in Scania.

The weather of September over the British Isles was variable. There was a dearth of sunshine except in the north-eastern coastal areas and an excess of rain except in the south-eastern coastal areas and in south-west Ireland. The total sunshine of 109 hours at Gorleston was the lowest September figure since records began there in 1908. The first ten days were very unsettled with considerable rain in most districts, notably from the 1st-3rd, the 7th-8th, and again on the 10th; 2.75in. fell at Borrowdale (Cumberland) on the 1st, 2.80in. at Tynywaun (Glamorgan) on the 2nd, and 1.69in. at Watlington (Oxford) on the 8th. The first two nights were unusually warm with minima of from 60°F. to 65°F. in many places, the reading of 64°F. at Kew on the night of the

2nd being a September record since 1871. After the 2nd there was a marked drop in temperature as the winds came from a northerly source, but on the 6th and 9th maxima again rose locally above 70°F. in the south. The 7th and 9th were sunny days, with 10.6hrs. at Norwich and Sheffield on the 7th and 11.2hrs. at Ilfracombe on the 9th. Thunderstorms occurred locally from the 7th-10th. The best weather of the month was enjoyed from the 12th-17th when an anticyclone passed slowly eastwards across the British Isles and central and southern Europe. Sunshine records were frequently good especially on the 12th and 16th; at Inchkeith 11.2hrs. bright sunshine were recorded on the 12th. There was a progressive rise in temperature in most places, the two highest temperatures reported were 80°F. at Tunbridge Wells on the 16th and 79°F. at Aberdeen on the 15th. Much fog occurred locally on the 16th and 17th. During the evening of the 17th a depression to the north-west of Scotland deepened considerably as it moved slowly eastwards, and cold northerly winds spread over the country. Pressure continued low until the 26th, and the weather cool and unsettled with bright periods. The 20th was sunny in Scotland and Ireland, giving 11.1hrs. at Aldergrove and the 21st sunny over the kingdom generally, giving 10.9 hrs. at Rothamsted and Winchester. Rainfall was scarce in south Scotland and north England but heavy at times in the south; Margate had 1.02in. on the 22nd. Maximum temperatures were well below 60°F. and sharp ground frosts occurred locally; 17°F. was registered at Renfrew on the 21st. From the 26th to 29th an anticyclone passed across the country giving mainly fair sunny weather, 10.5hrs. at Cardiff on the 26th and at Collumpton on the 28th, with ground frosts locally. By the 29th a depression was approaching the English Channel, temperature rose slowly and rain fell heavily in south-west England on the 29th and over the kingdom generally on the 30th. The distribution of bright sunshine for the month was as follows :—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway	93	—22	Liverpool	128	0
Aberdeen	137	+13	Ross-on-Wye	128	— 8
Dublin	110	—29	Falmouth	99	— 64
Birr Castle	99	—27	Gorleston	109	—53
Valentia	114	—19	Kew	103	—42

Miscellaneous notes on weather abroad culled from various sources.

A storm of unusual violence broke over Marseilles on the 9th causing considerable floods in parts of the city and many animals were destroyed. A severe storm swept across southern Ticino, Switzerland, on the 22nd where vineyards and crops

were ruined and many landslides occurred. A forest fire continued in the mountains near Amsteg in Uri (Switzerland) during the week ending the 24th in spite of the heavy rainfall on the 18th. Thunderstorms and heavy rain during the 28th and 29th did much damage along the Riviera coast from Fréjus to Nice. The month of September up to the 26th proved one of the hottest and driest for many years in Austria (*The Times*, September 12th-26th).

Floods made a breach of 50yds. in the Madras railway near Poona at the beginning of the month. General rains fell in the Central Provinces and Berars and in the United Provinces early in the month, while local rains were reported in Gujerat. Towards the later part of the month the monsoon was active in Burma and north-east India, and later still it was gradually withdrawing from the interior of the country. Gales occurred in Syria and Palestine about the 17th (*The Times*, September 2nd-30th).

Rain delayed harvesting in some parts of Canada at the beginning of the month, but the weather had cleared by the 10th and favourable conditions for harvesting were experienced during the following week. A severe gale swept down the Annapolis Valley (Nova Scotia) on the 17th, destroying much of the apple crop. On the 5th a hurricane swept across the Bahamas, the winds reached their greatest strength over Abaco Island where much damage was done, 14 people were killed, including 5 drowned by tidal wave. A hurricane swept across the Virgin Islands on the 26th and then passed across Porto Rico and Santo Domingo.* A storm passing to the north side of Jamaica on the 29th destroyed many banana trees. The Rio Grande River overflowed its banks early in the month and serious floods occurred between Penitas and Rio Grande City, Texas. Temperature was considerably above normal in the eastern United States, the Lake Region and Ohio Valley at the beginning of the month, reaching 92°F. at New York on the 2nd. A cooler spell then passed eastwards across the States followed by another warm spell. Rainfall was generally below normal except early in the month in the Gulf States and locally along the Atlantic coast about the middle of the month.† (*The Times*, September 3rd-30th, and *Washington, D.C., U.S. Dept. Agric. Daily Weather Map and Weekly Weather and Crop Bulletin.*)

Rainfall, September, 1932—General Distribution

England and Wales	144	per cent of the average 1881-1915.
Scotland	137	
Ireland	109	
British Isles	135	

* See p. 217. † See p. 216.

Rainfall: September, 1932: England and Wales.

Co.	Station	In.	Per-cent. of Av.	Co.	Station	In.	Per-cent. of Av.
Lond.	Camden Square	2·56	141	*Leics.*	Belvoir Castle	1·95	104
Sur.	Reigate, Alvington	2·04	102	*Rut.*	Ridlington	3.68	192
Kent.	Tenterden, Ashenden	1·85	86	*Lincs.*	Boston, Skirbeck	2·39	136
,,	Folkestone, Boro. San.	2·27	...	,,	Cranwell Aerodrome	2·01	113
,,	Margate, Cliftonville	1·93	98	,,	Skegness, Marine Gdns	2·50	138
,,	Sevenoaks, Speldhurst	2·03	...	,,	Louth, Westgate	2·09	103
Sus.	Patching Farm	3·12	130	,,	Brigg, Wrawby St.	1·66	...
,,	Brighton, Old Steyne	2·35	112	*Notts.*	Worksop, Hodsock	1·29	85
,,	Heathfield, Barklye	3·27	133	*Derby.*	Derby, L. M. & S. Rly.	2·02	122
Hants.	Ventnor, Roy. Nat. Hos.	3·43	138	,,	Buxton, Devon Hos.	4·22	130
,,	Fordingbridge, Oaklnds	3·91	182	*Ches.*	Runcorn, Weston Pt.	2·49	93
,,	Ovington Rectory	3·70	162	,,	Nantwich, Dorfold Hall	2·20	...
,,	Sherborne St. John	3·16	154	*Lancs.*	Manchester, Whit Pk.	3·29	138
Berks.	Wellington College	2·43	132	,,	Stonyhurst College	7·84	205
,,	Newbury, Greenham	3·73	185	,,	Southport, Hesketh Pk	4·16	151
Herts.	Welwyn Garden City	1·71	...	,,	Lancaster, Strathspey	5·31	...
Bucks.	H. Wycombe, Flackwell	2·54	...	*Yorks.*	Wath-upon-Dearne	1·23	78
Oxf.	Oxford, Mag. College	2·39	142	,,	Bradford, Lister Pk.	2·81	136
Nor.	Pitsford, Sedgebrook	3·07	171	,,	Oughtershaw Hall	9·16	...
,,	Oundle	2·39	...	,,	Wetherby, Ribston H.	2·32	129
Beds.	Woburn, Crawley Mill	2·01	112	,,	Hull, Pearson Park	1·67	97
Cam.	Cambridge, Bot. Gdns.	1·69	105	,,	Holme-on-Spalding	2·27	...
Essex.	Chelmsford, County Lab	1·81	105	,,	West Witton, Ivy Ho.	3·33	155
,,	Lexden Hill House	1·50	...	,,	Felixkirk, Mt. St. John	2·37	130
Suff.	Haughley House	1·10	...	,,	Pickering, Hungate	2·60	136
,,	Campsea Ashe	1·48	77	,,	Scarborough	2·25	126
Norf.	Norwich, Eaton	...	...	,,	Middlesbrough	2·19	132
,,	Wells, Holkham Hall	2·47	130	,,	Balderdale, Hury Res.	4·35	174
,,	Swaffham, The Villa	1·96	89	*Durh.*	Ushaw College	2·39	119
Wilts.	Devizes, Highclere	3·64	178	*Nor.*	Newcastle, Town Moor	2·29	112
,,	Bishops Cannings	3·91	178	,,	Bellingham, Highgreen	4·72	217
Dor.	Evershot, Melbury Ho.	5·21	196	,,	Lilburn Tower Gdns.	4·76	202
,,	Creech Grange	3·86	14[illegible]	*Cumb.*	Geltsdale	5·71	...
,,	Shaftesbury, Abbey Ho.	3·06	126	,,	Carlisle, Scaleby Hall	4·52	167
Devon.	Plymouth, The Hoe	5·58	101	,,	Borrowdale, Seathwaite	14·50	154
,,	Launceston, Werringt'n	5·63	...	,,	Borrowdale, Moraine	11·55	...
,,	Holne, Church Pk. Cott.	7·38	205	,,	Keswick, High Hill	6·98	...
,,	Cullompton	5·34	237	*West.*	Appleby, Castle Bank	3·76	148
,,	Sidmouth, Sidmount	3·95	172	*Glam.*	Cardiff, Ely P. Stn.	5·13	165
,,	Filleigh, Castle Hill	6·23	...	,,	Treherbert, Tynywaun	11·79	...
,,	Barnstaple, N. Dev. Ath	4·80	178	*Carm.*	Carmarthen Friary	4·34	125
,,	Dartm'r, Cranmere Pool	10·80	...	*Pemb.*	Haverfordwest, School	3·43	96
Corn.	Redruth, Trewirgie	4·94	158	*Card.*	Aberystwyth	3·52	...
,,	Penzance, Morrab Gdn.	5·13	175	,,	Cardigan, County Sch.	3·03	...
,,	St. Austell, Trevarna	5·46	171	*Brec.*	Crickhowell, Talymaes	4·20	...
Soms.	Chewton Mendip	7·29	237	*Rad.*	Birm W.W. Tyrmynydd	4·39	114
,,	Long Ashton	5·82	243	*Mont.*	Lake Vyrnwy	6·77	190
,,	Street, Millfield	4·38	194	*Denb.*	Llangynhafal	2·70	122
Glos.	Blockley	3·11	...	*Mer.*	Dolgelly, Bryntirion	6·68	157
,,	Cirencester, Gwynfa	3·42	155	*Carn.*	Llandudno	2·95	129
Here.	Ross, Birchlea	3·65	190	,,	Snowdon, L. Llydaw 9	17·15	...
,,	Ledbury, Underdown	3·31	173	*Ang.*	Holyhead, Salt Island	2·69	100
Salop.	Church Stretton	2·63	129	,,	Lligwy	4·37	...
,,	Shifnal, Hatton Grange	2·01	104	*Isle of Man*			
Worc.	Ombersley, Holt Lock	2·47	139		Douglas, Boro' Cem.	4·78	145
War.	Birminghm, Edgbaston	3·00	168	*Guernsey*			
Leics.	Thornton Reservoir	2·49	138		St. Peter P't. Grange Rd	4·59	176

Rainfall: September, 1932: Scotland and Ireland.

Co.	Station	In.	Per-cent. of Av.	Co.	Station	In.	Per-cent. of Av.
Wigt .	Pt. William, Monreith	6·16	211	*Suth* .	Melvich	4·99	...
,, .	New Luce School	5·23	146	,, .	Loch More, Achfary	14·78	257
Kirk .	Carsphairn, Shiel	8·61	162	*Caith* .	Wick	3·82	153
Dumf .	Dumfries, Crichton, R.I	4·05	...	*Ork* .	Pomona, Deerness	...	...
,, .	Eskdalemuir Obs.	6·20	168	*Shet* .	Lerwick	5·09	169
Roxb .	Branxholm	4·18	187	*Cork* .	Caheragh Rectory	2·40	...
Selk .	Ettrick Manse	5·32	147	,, .	Dunmanway Rectory	3·36	82
Peeb .	West Linton	4·10	...	,, .	Ballinacurra	2·04	81
Berw .	Marchmont House	3·54	147	,, .	Glanmire, Lota Lo.	2·03	72
E. Lot .	North Berwick Res.	2·14	102	*Kerry* .	Valentia Obsy	2·56	62
Midl .	Edinburgh, Roy. Obs.	2·48	121	,, .	Gearahameen	5·80	...
Lan .	Auchtyfardle	4·49	...	,, .	Killarney Asylum	2·67	75
Ayr .	Kilmarnock, Kay Pk.	4·75	...	,, .	Darrynane Abbey	2·82	79
,, .	Girvan, Pinmore	5·59	146	*Wat* .	Waterford, Gortmore	1·61	59
Renf .	Glasgow, Queen's Pk.	4·87	176	*Tip* .	Nenagh, Cas. Lough	4·38	156
,, .	Greenock, Prospect H.	5·77	121	,, .	Roscrea, Timoney Park	2·74	...
Bute .	Rothesay, Ardencraig.	4·96	...	,, .	Cashel, Ballinamona	1·84	75
,, .	Dougarie Lodge	4·37	...	*Lim* .	Foynes, Coolnanes	3·85	138
Arg .	Ardgour House	12·26	...	,, .	Castleconnel Rec.	4·08	...
,, .	Glen Etive	...	...	*Clare* .	Inagh, Mount Callan	...	...
,, .	Oban	5·10	116	,, .	Broadford, Hurdlest'n.	4·59	...
,, .	Poltalloch	4·55	100	*Wexf* .	Gorey, Courtown Ho.	1·87	76
,, .	Inveraray Castle	8·57	134	*Kilk* .	Kilkenny Castle	1·45	63
,, .	Islay, Eallabus	5·32	127	*Wick* .	Rathnew, Clonmannon	1·42	...
,, .	Mull, Benmore	...	...	*Carl* .	Hacketstown Rectory	2·35	84
,, .	Tiree	...	...	*Leix* .	Blandsfort House	2·56	94
Kinr .	Loch Leven Sluice	2·68	104	,, .	Mountmellick	...	...
Perth .	Loch Dhu	5·15	90	*Offaly* .	Birr Castle	3·71	162
,, .	Balquhidder, Stronvar	4·24	...	*Kild're* .	Monasterevin	2·26	...
,, .	Crieff, Strathearn Hyd.	2·05	72	*Dublin*	Dublin, FitzWm. Sq.	2·22	116
,, .	Blair Castle Gardens	1·92	81	,, .	Balbriggan, Ardgillan.	2·01	99
Angus .	Kettins School	1·76	88	*Meath* .	Beaupare, St. Cloud	3·58	...
,, .	Dundee, E. Necropolis	1·56	75	,, .	Kells, Headfort	3·47	130
,, .	Pearsie House	1·68	...	*W.M.* .	Moate, Coolatore	4·07	...
,, .	Montrose, Sunnyside	2·27	114	,, .	Mullingar, Belvedere	4·17	156
Aber .	Braemar, Bank	2·65	105	*Long* .	Castle Forbes Gdns.	3·30	115
,, .	Logie Coldstone Sch.	3·58	154	*Gal* .	Ballynahinch Castle	4·86	102
,, .	Aberdeen, King's Coll.	3·59	162	,, .	Galway, Grammar Sch.	...	...
,, .	Fyvie Castle	3·65	140	*Mayo* .	Mallaranny	5·36	...
Moray	Gordon Castle	3·34	134	,, .	Westport House	4·32	122
,, .	Grantown-on-Spey	3·80	153	,, .	Delphi Lodge	8·01	106
Nairn.	Nairn	2·22	101	*Sligo* .	Markree Obsy	4·66	138
Inv's .	Ben Alder Lodge	4·41	...	*Cavan*.	Belturbet, Cloverhill	3·50	141
,, .	Kingussie, The Birches	2·61	...	*Ferm* .	Enniskillen, Portora	...	...
,, .	Loch Quoich, Loan	...	...	*Arm* .	Armagh Obsy	3·11	126
,, .	Glenquoich	12·93	150	*Down*.	Fofanny Reservoir	3·38	...
,, .	Inverness, Culduthel R.	3·41	...	,, .	Seaforde	2·75	100
,, .	Arisaig, Faire-na-Squir	6·11	...	,, .	Donaghadee, C. Stn.	3·20	134
,, .	Fort William, Glasdrum	6·83	...	,, .	Banbridge, Milltown	2·56	104
,, .	Skye, Dunvegan	6·60	...	*Antr* .	Belfast, Cavehill Rd.	3·94	...
,, .	Barra, Skallary	4·72	...	,, .	Glenarm Castle	5·56	...
R & C .	Alness, Ardross Castle	3·93	135	,, .	Ballymena, Harryville	3·78	121
,, .	Ullapool	5·23	140	*Lon* .	Londonderry, Creggan	4·20	127
,, .	Achnashellach	12·94	...	*Tyr* .	Omagh, Edenfel	4·79	157
,, .	Stornoway	4·76	121	*Don* .	Malin Head	3·29	...
Suth .	Lairg	4·28	151	,, .	Dunfanaghy	4·50	...
,, .	Tongue	5·19	164	,, .	Killybegs, Rockmount.	5·41	118

Climatological Table for the British Empire, April, 1932

STATIONS	PRESSURE: Mean of Day M.S.L.	PRESSURE: Diff. from Normal	TEMPERATURE: Absolute Max.	TEMPERATURE: Absolute Min.	TEMPERATURE: Mean Values Max.	TEMPERATURE: Mean Values Min.	TEMPERATURE: Mean Values ½ max. and min.	TEMPERATURE: Mean Values Diff. from Normal	TEMPERATURE: Mean Wet Bulb	Relative Humidity	Mean Cloud Am'nt	PRECIPITATION: Am'nt	PRECIPITATION: Diff. from Normal	PRECIPITATION: Days	BRIGHT SUNSHINE: Hours per day	BRIGHT SUNSHINE: Percentage of possible
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F	°F	%	0—10	in.	in.			
London, Kew Obsy.	1008·1	— 6·3	65	33	52·3	39·7	46·0	— 1·3	41·4	84	7·4	2·23	+ 0·78	22	3·9	28
Gibraltar	1016·9	+ 0·4	77	46	68·5	51·4	59·9	— 1·1	51·2	83	4·4	4·04	+ 1·36	9	..	..
Malta	1015·4	+ 2·0	74	45	64·6	53·9	59·3	— 1·6	54·6	74	4·7	0·15	— 0·71	2	9·4	72
St. Helena	1013·1	0·0	72	59	68·2	60·5	64·3	— 1·0	60·7	91	8·5	0·68	..	10	..	..
Sierra Leone	1012·0	+ 1·2	90	70	87·7	74·4	81·1	— 1·3	76·0	78	5·1	8·71	+ 4·65	12	..	..
Lagos, Nigeria	1009·5	+ 0·1	92	72	88·8	78·2	83·5	+ 0·7	78·8	78	8·0	3·80	— 2·28	9	7·1	58
Kaduna, Nigeria	1008·7	— 3·0	102	65	97·2	71·9	84·5	+ 3·0	73·9	61	5·7	1·24	— 1·84	5	8·5	69
Zomba, Nyasaland	1011·5	— 1·0	85	59	79·6	64·0	71·8	+ 2·5	..	80	7·6	2·95	— 0·71	7	..	..
Salisbury, Rhodesia	1015·6	— 0·2	81	46	76·5	55·0	65·7	0·0	58·8	68	5·0	2·83	+ 1·84	13	5·5	47
Cape Town	1013·8	— 2·6	91	42	78·0	57·7	67·9	+ 4·7	59·4	86	4·5	0·33	— 1·54	3	..	..
Johannesburg	1016·4	+ 1·1	78	45	73·0	52·4	62·7	+ 2·7	52·0	56	2·8	1·47	— 0·27	5	8·5	74
Mauritius	1013·1	— 0·9	84	63	81·0	71·2	76·1	+ 0·3	73·0	77	6·2	13·83	+ 9·36	26	6·8	59
Calcutta, Alipore Obsy.	1006·8	+ 0·5	105	70	98·4	76·5	87·5	+ 1·9	76·0	77	1·8	1·07	— 1·11	4*	..	..
Bombay	1009·4	+ 0·6	94	75	89·4	77·4	83·4	+ 0·3	75·7	75	3·9	0·00	— 0·05	0*	..	..
Madras	1008·8	+ 0·4	102	70	92·1	76·5	84·3	— 1·0	77·5	74	4·4	0·58	— 0·05	3*	..	..
Colombo, Ceylon	1010·1	+ 1·4	89	73	87·2	76·3	81·7	— 1·0	78·4	78	7·0	11·27	+ 1·54	15	7·2	59
Singapore	1009·5	+ 0·6	92	71	87·4	74·1	80·7	— 0·9	77·5	81	6·8	6·37	— 1·26	17	5·6	46
Hongkong	1012·6	0·0	86	62	75·2	67·6	71·4	+ 0·6	68·2	85	9·1	3·70	— 1·95	11	3·1	25
Sandakan	..	..	90	73	86·7	75·5	81·1	— 1·1	77·6	82	..	12·[illegible]0	+ 7·61	12	..	..
Sydney, N.S.W.	1015·1	— 3·3	82	48	72·7	57·6	65·1	+ 0·4	59·7	77	5·3	3·49	— 2·03	17	6·5	58
Melbourne	1015·2	— 4·3	78	43	67·2	52·5	59·9	+ 0·4	55·1	82	7·8	5·42	+ 3·25	21	3·7	33
Adelaide	1016·2	— 3·7	79	47	69·5	54·3	61·9	— 2·0	56·0	69	7·9	4·63	+ 2·90	16	3·6	32
Perth, W. Australia	1017·1	— 1·3	87	48	74·4	57·2	65·8	— 1·0	57·6	65	5·2	3·16	+ 1·51	14	6·3	56
Coolgardie	1017·5	— 1·1	87	42	75·9	52·6	64·3	— 0·7	54·7	56	3·9	1·15	+ 0·19	5	..	..
Brisbane	1015·1	— 2·5	88	54	79·6	64·2	71·9	+ 1·6	64·9	70	5·6	5·36	+ 1·82	15	6·3	55
Hobart, Tasmania	1013·0	— 1·8	70	43	60·2	50·0	55·1	— 0·1	51·1	77	8·0	3·10	+ 1·25	19	2·9	27
Wellington, N.Z.	1019·0	+ 0·9	70	40	60·7	50·8	55·7	— 1·4	53·2	81	7·0	2·69	— 1·19	15	4·4	40
Suva, Fiji	1010·2	— 0·4	89	68	83·7	73·3	78·5	— 0·1	74·5	81	7·2	11·51	— 0·70	22	4·7	40
Apia, Samoa	1008·1	— 1·8	90	70	85·2	74·6	79·9	+ 1.0	76·9	82	6·9	12·81	+ 2·66	23	5·3	45
Kingston, Jamaica	1011·9	— 2·2	89	69	86·0	72·0	79·0	+ 0·6	71·3	83	4·4	2·84	+ 1·60	12	6·7	54
Grenada, W.I.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Toronto	1015·1	— 1·0	76	20	48·2	33·4	40·8	— 1·3	34·7	65	6·1	1·75	— 0·54	9	5·4	40
Winnipeg	1020·7	+ 4·0	72	—18	47·2	29·4	38·3	+ 0·6	..	..	5·7	0·92	— 0·48	6	..	..
St. John, N.B.	1010·9	— 2·5	66	24	47·4	32·3	39·9	+ 0·9	35·2	71	5·9	2·98	— 0·53	10	5·4	40
Victoria, B.C.	1014·5	— 3·0	63	39	54·7	43·5	49·1	+ 1·2	46·1	80	6·7	1·16	— 0·36	12	6·1	45

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.

*For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.

Winnipeg	1020·7	+ 4·0	72	−18	47·2	29·4	38·3	+ 0·6	..	..	5·7	0·92	— 0·48	6	..	..
St. John, N.B.	1010·9	— 2·5	66	24	47·4	32·3	39·9	+ 0·9	35·2	71	5·9	2·98	— 0·53	10	5·4	40
Victoria, B.C.	1014·5	— 3·0	63	39	54·7	43·5	49·1	+ 1·2	46·1	80	6·7	1·16	— 0·36	12	6·1	45

* For Indian stations a rain day is a day on which ·01 in. or more rain has fallen.